Highs and lows

HIGHS AND LOWS: A PREVIOUSLY UNATTESTED TONE SPLIT FROM VOWEL HEIGHT IN METNYO AMBEL[1]

LAURA ARNOLD
University of Edinburgh

ABSTRACT

Ambel is a tonal Austronesian (South Halmahera-West New Guinea) language, spoken to the west of New Guinea. There are two dialects of Ambel: Metsam and Metnyo. In this paper, the segments and tones of proto-Ambel monosyllables are reconstructed. Proto-Ambel had two tones, *High and *Rise; toneless monosyllables are also reconstructed. The tonal phonology of Metsam Ambel is identical with the proto-Ambel system. The tone system of Metnyo Ambel, however, has undergone two innovations: an unconditioned merger of *Rise and toneless syllables; and a primary split affecting proto-Ambel toneless syllables. Notably, this latter change was conditioned by vowel height: toneless monosyllables with high vowel nuclei (*i or *u) remained toneless, while those with non-high vowel nuclei (*e, *a, or *o) merged with *High tone. The diachronic development of High tone on non-high vowels has not previously been attested. The possible mechanisms that caused this split will therefore be given special attention. Based on experimental phonetic evidence, it will be argued that the split was caused by the neutralisation, in low-pitched contexts, of the intrinsic differences in fundamental frequency found between high and low vowels; combined with the utilisation of Intrinsic Pitch, an auditory mechanism used to compensate for intrinsic *f*0 differences.

1. INTRODUCTION

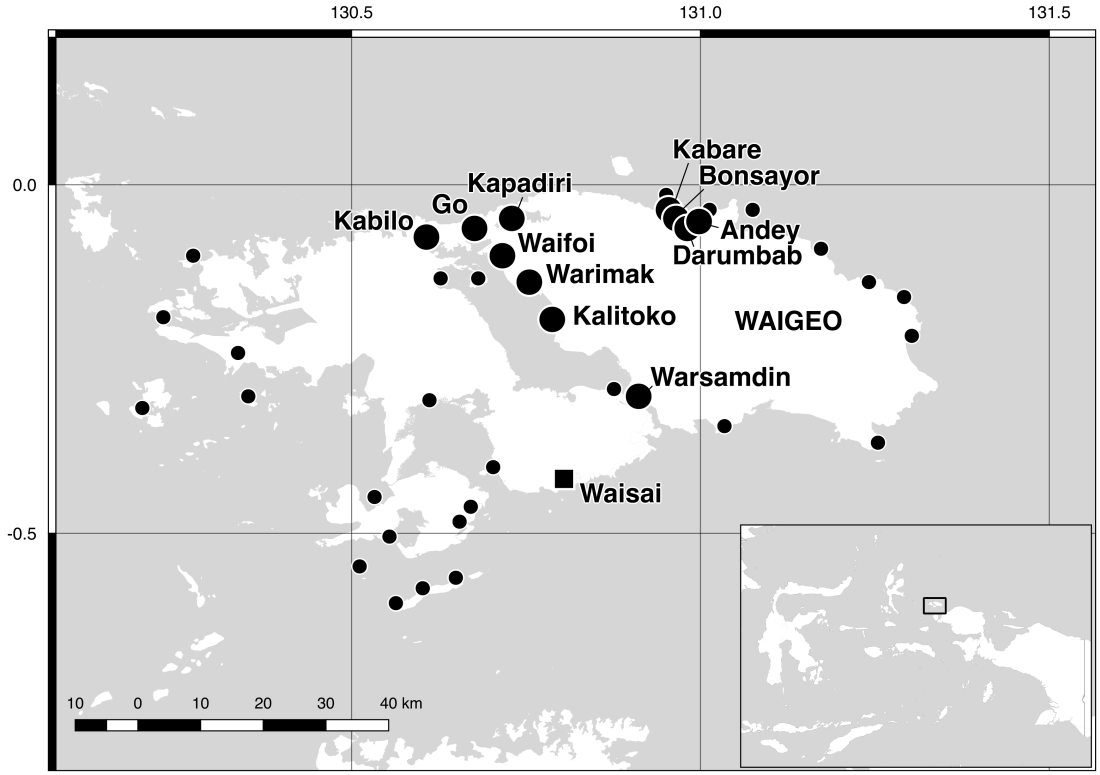
Ambel is an Austronesian language spoken by around 1,600 people on Waigeo. Waigeo is the northernmost island in the Raja Ampat (RA) archipelago, which

[1] Feedback on earlier drafts of this paper was provided by Pavel Iosad, Dave Kamholz, and an anonymous reviewer: I gratefully acknowledge their input. I would also like to thank Carlos Gussenhoven, Bob Ladd, Ben Macaulay, Bert Remijsen, Laurent Sagart, and participants of the 14th International Conference on Austronesian Linguistics (where an earlier version of this paper was presented), for helpful discussions and suggestions about the data discussed here; as well as respondents to a request for information on the histling mailing list, especially Ryan Bennett and Bonny Sands.

The speech data on which this paper is based were recorded from Martinus Wakaf, Andarias Lapon, Alfred Gaman, Aplena Awom, Yubel Kein, Magdalena Wakaf, Konstantina Wakaf, Selep Wakaf, and Darius Wakaf. I offer them my sincere thanks for their collaboration. The data were collected during five trips to Waigeo, between 2014-2017. These trips were funded by the British Academy, the University of Edinburgh, the Endangered Languages Documentation Programme, the Foudation for Endangered Languages, and the Firebird Foundation. I gratefully acknowledge their financial support.

lies just off the western tip of New Guinea, in West Papua province, Indonesia. Within Austronesian, Ambel belongs to the South Halmahera-West New Guinea (SHWNG) subbranch, the putative and lesser-known sister of Oceanic. The villages on Waigeo in which Ambel is spoken are shown in Figure 1.

Figure 1: The Ambel language area



Unusually for an Austronesian language, Ambel has lexical tone.[2] There are two dialects of Ambel, both of which are tonal: Metsam, spoken in Warsamdin and Kalitoko, to the south of the Ambel language area; and Metnyo, spoken in the remaining nine Ambel villages.[3] This paper is the first attempt at reconstructing

[2] Other Austronesian languages with lexical tone are found in the SHWNG, Oceanic, and Chamic subbranches. Within SHWNG, and as will be discussed in more detail below, at least two other languages spoken in Raja Ampat have tone systems: Ma'ya and Matbat (Remijsen 2001a, 2001b, 2002, 2007). Other tonal SHWNG languages are found further to the east, in the Cenderawasih Bay region: Yerisiam, Yaur, and Moor (Kamholz 2014), as well as possibly Waropen (van Velzen 1994, n.d.) and Wooi (Himmelmann 2018:370 f.n.19). Within Oceanic, the following languages are tonal: the North Huon Gulf languages Yabem and Bukawa (Ross 1993); Awad Bing, spoken in the Astrolabe Bay region of Papua New Guinea (Cahill 2011); Kara, Barok, and Patpatar, all spoken in New Ireland (Hajek 1995); and Cèmuhî, Paicî, Drubea, Numèè, and Kwenyii, all spoken in New Caledonia (Rivierre 1993, 2001). Finally, the Chamic languages Eastern Cham (Edmonson and Gregerson 1993) and Utsat (Maddieson and Pang 1993) have both developed tone through contact with Chinese languages.

[3] There are also some speakers of both dialects in Waisai, the administrative centre of Waigeo on the south coast of the island.

the word-prosodic system of proto-Ambel, based on monosyllabic cognates in the two dialects; it thus represents a modest contribution to historical and comparative studies in this little-known subbranch of Austronesian.

In the course of this paper I will show that the history of tone in Ambel presents an interesting puzzle: in the Metnyo dialect, there was a tone split conditioned by vowel height. In this split, monosyllables reconstructed as toneless in proto-Ambel remained toneless if the vowel nucleus was high (i.e., *i or *u), and developed High tone if the vowel was non-high (i.e., *e, *a, or *o). This split is significant for two reasons. First, tonal developments conditioned by vowel height are very rare (see e.g. Hombert 1977, 1978; Hombert et al 1979; Kingston 2011: §6; Köhnlein & van Oostendorp 2017: §2). Second, the direction in which the split was conditioned has not previously been attested – in all other cases described thus far, vowels produced higher in the mouth develop higher tone than those produced lower in the mouth. Following an introduction to Ambel in section 2, and the presentation of the data and reconstruction of proto-Ambel monosyllables in section 3, the possible articulatory and perceptual mechanisms underlying this previously unattested tone split will be explored in section 4. The source of Ambel tone will be briefly considered in section 5, and the conclusions of this paper will be presented in section 6.

2. AMBEL: AN OVERVIEW

Aside from some lexical and minor morphosyntactic differences, the two dialects of Ambel are very similar. The segmental inventories of the two dialects are simple. Metsam Ambel has five vowels (/i e a o u/) and 14 native consonants (/p t k b d g s f m n r l w j/). The phonological inventory of Metnyo is identical, with the exception that /h/ substitutes /f/.[4] The main phonological differences between Metsam and Metnyo Ambel are found in the tone systems.

[4] Older speakers of Metnyo Ambel realise /h/ as [h], [ɸ], or [f], showing that the change *f > /h/ is still in progress. Both dialects also have the loan phonemes /tʃ/, /dʒ/, and /ŋ/.

The orthographic system used to transcribe Ambel and related languages in this paper is nearly identical to the IPA, with the following exceptions: <y> = /j/, <c> =/tʃ/, <j> = /dʒ/, and <ng> = /ŋ/. High tone is transcribed with an acute accent <á>, and Rise tone with a caron <ǎ>. Note, however, that phonetic transcriptions, given in square brackets, follow the IPA.

The tonal phonology of Metnyo Ambel is described in Arnold (2018a, 2018b). The tone system of this dialect is binary and privative: High (H) syllables contrast with toneless (Ø) syllables, for example in the minimal pair *túŋ* 'moon' vs. *tuŋ* 'thorn'. Utterance-medially, H syllables are realised High [H], and toneless syllables are realised Low [L].[5] Toneless syllables immediately following syllables realised [H] systematically assimilate to the preceeding [H] target, and are realised [H ~ M].

The Metnyo Ambel system is culminative, in that there is a maximum of one H syllable per morpheme.[6] When two or more H morphemes come together to form a word – for example, in the systems of verbal subject and possessive marking, and in nominal and verbal compounding – culminativity is enforced at the level of the word. In the verbal subject marking and possessive marking paradigms, culminativity is enforced through a process of progressive H-deletion: the first H syllable is realised [H], and all subsequent syllables behave as if they were toneless. In nominal and verbal compounding, the prosodic headedness depends on the semantic headedness of the compound. More details on these processes can be found in Arnold (2018b).

However, while tone is culminative in Metnyo Ambel, it is not obligatory, in that words without any tonal specification are attested (e.g. *we* 'water', *kata* 'cape, headland'). The non-obligatory use of fundamental frequency to make lexical distinctions is what distinguishes the word prosodic system of Metnyo Ambel from a stress accent system (in which *f*0 may be used obligatorily and culminatively as a marker of metrical prominence; see Hyman 2006, 2009).

Work on the tone system of Metsam Ambel is still preliminary. Monosyllabic words can be divided into three groups, depending on utterance-medial realisation: those realised [H] (e.g. [páj] 'heron'), those realised Rise [LH] (e.g.

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[5] Phonetically [L] syllables are analysed as toneless (rather than as underlyingly /L/) as this is the default realisation of syllables; and because L is not active at the phonological level, in that an underlying /L/ specification is not required '…to express generalizations about the phonological system' (Clements 2001:72; cf. Hyman 2016 on privativity vs. equipollence in the tone systems of Amazonian languages).

[6] The majority of Ambel morphemes are monosyllabic or disyllabic, although trisyllabic morphemes are not uncommon. Monomorphemic words up to five syllables long and morphologically complex words up to six syllables long are attested.

[běj] ‘sago’), and those realised [L] (e.g. [gèj] ‘areca nut’). For the purposes of this paper, [H] monosyllables are analysed as bearing High (H) tone; [LH] monosyllables are analysed as bearing Rise (LH) tone;[7] and [L] syllables are analysed as toneless (Ø), as they are in Metnyo Ambel.[8] With regards to the polysyllabic data, research is still ongoing to determine whether tonal specification is culminative in Metsam, as it is in Metnyo, or whether tone is obligatory in polysyllabic words. It is also unknown at present whether tone in Metsam targets the syllable (as in Metnyo), or whether tonal specification is mapped to the word (as is found in some languages of New Guinea; see Donohue 1997).

Besides Ambel, several other SHWNG languages are spoken in RA today, including Biak, Ma'ya, Matbat, Biga, Bata, and Gebe. Speakers of Biak migrated to the archipelago comparatively recently (according to tradition, some 500 years ago; Andaya 1993: 104); Biak is classified by Kamholz (2014) in the Cenderawasih Bay subbranch of SHWNG. The other languages, however, including Ambel, have been spoken in RA for much longer, and are members of the Raja Ampat-South Halmahera (RASH) branch of SHWNG (Kamholz 2014).[9] Ambel is not the only tonal RASH language spoken in Raja Ampat: both Ma'ya and Matbat are known to have lexical tone (Remijsen 2001a, 2001b, 2002, 2007).[10] Preliminary evidence presented in Kamholz (2016) suggests that Biga,

[7] Phonetically [LH] syllables are analysed as underlyingly /LH/, rather than /L/, due to the utterance-medial [H] final target. If we were to analyse [LH] syllables as /L/, we would have to posit a rule which introduced a [H] final target when the syllable is utterance-medial. Such a rule would be unmotivated by any other feature of the phonological system; it is thus more parsimonious to analyse these syllables as /LH/.

[8] Further data may show that [L] monosyllables in Metsam are better analysed as /L/: for example, if it transpires that /L/ is phonologically active. For the purposes of this paper, however, it does not matter whether [L] monosyllables are analysed /L/ or /Ø/ – the relevant point is that they are realised [L].

[9] The internal classification of the RASH branch is ongoing: while the RASH languages spoken in southern Halmahera, to the west of Raja Ampat, form a primary branch (Kamholz 2014), it is unclear whether the RASH languages spoken in and around Raja Ampat form a separate primary branch. Kamholz (2014), based on phonological and morphological innovations in the languages, concludes that these languages constitute several primary branches of RASH: Ambel-Biga, Ma'ya-Matbat, Fiawat, and As. However, Kamholz (2015), a reconstruction of proto-SHWNG morphology, casts doubt on the validity of the Ma'ya-Matbat branch (although cf. Arnold 2018c, who presents evidence in support of a branch which includes Ma'ya and Matbat); and Kamholz (2017: 10 f.n. 4) has since retracted the Ambel-Biga branch.

[10] Ma'ya in fact has both a system of lexical tone and a system of contrastive lexical stress, a highly unusual combination cross-linguistically (Remijsen 2001a, 2001b, 2002). Metnyo Ambel is

Bata, and nearby As, all RASH languages, may also have tone systems. The presence of tone in other languages spoken in RA will be relevant to our discussion in section 5, on the origin of tone in proto-Ambel.

3. TONAL CORRESPONDENCES

The primary purpose of this study is to compare monosyllabic cognates in Metsam and Metnyo Ambel, and reconstruct the segments and tones of the ancestral forms in proto-Ambel. The reason for focussing on monosyllables in the first instance is that, as described above, the word prosody of Metsam polysyllables is at present poorly understood. Despite this, comparison of monosyllabic data allows us to make a first step towards the reconstruction of the word-prosodic system and the segmental phonology of the proto-language.

62 monosyllabic cognates between Metsam and Metnyo have so far been identified. These cognates can be sorted into five groups, depending on the tonal specification of the reflexes in the daughter dialects. In the first group, H monosyllables in Metsam correspond to H monosyllables in Metnyo. This set will be referred to as correspondence set A, and will be discussed in section 3.1. Toneless monosyllables in Metsam correspond either to toneless or to H monosyllables in Metnyo. The first group will be referred to as correspondence set B, and the second as correspondence set C; sets B and C will be discussed together in section 3.2. Finally, Metsam LH monosyllables can correspond to either toneless (correspondence set D) or H (correspondence set E) monosyllables in Metnyo – both will be discussed in section 3.3. As the cognates for each of the sets are presented, and the proto-Ambel forms are reconstructed, the phonological changes between the proto-language and the daughter dialects will be discussed. A summary of these changes, together with evidence showing the order in which they occurred, can be found in section 3.4.

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known not to have either predictable or contrastive stress (Arnold 2018a: 71-2). It is unknown, however, whether Metsam only has lexical tone, as in Metnyo; or whether it combines lexical tone with lexical stress, as in Ma'ya. This is another feature of the word prosody of Metsam polysyllables that requires further data and analysis.

3.1 Correspondence set A: Metsam H :: Metnyo H

The reconstruction of the proto-Ambel (pA) forms based on the cognates in set A is straightforward: as all 22 H monosyllables in Metsam correspond to H in Metnyo, they are reconstructed with *H tone in pA. The relevant data, along with the pA reconstructions, are given in Table 1.

Table 1: Correspondence set A (Metsam H :: Metnyo H)

		Metsam	**Metnyo**	**Proto-Ambel**
1.	‘arrive’	dók	dók	*dók
2.	‘banana’	tál	tál	*tál
3.	‘blue’	byáw	byáw	*byáw
4.	‘die’	mnát	mát	*mnát
5.	‘eight’	wál	wál	*wál
6.	‘four’	fát	hát	*fát
7.	‘go, walk’	tán	tán	*tán
8.	‘ground, earth’	bát	bát	*bát
9.	‘heron’	páy	páy	*páy
10.	‘island’	yé	yé	*yé
11.	‘low tide’	mú	mú	*mú
12.	‘man, male’	mán	mán	*mán
13.	‘mother’	nén	nén	*nén
14.	‘mountain’	íl	íl	*íl
15.	‘person’	mét	mét	*mét
16.	‘sea turtle’	fín	hín	*fín
17.	‘see’	ém	ém	*ém
18.	‘seven’	fít	hít	*fít
19.	‘swim’	lá	lá	*lá
20.	‘three’	túl	túl	*túl
21.	‘wash’	sów	sów	*sów
22.	‘wood, tree’	áy	áy	*áy

3.2 Correspondence sets B and C: Metsam Ø :: Metnyo Ø, H

We turn now to the 39 toneless Metsam monosyllables that have cognates in Metnyo. Of these, 24 of the Metnyo cognates are toneless (correspondence set B); the remaining 15 are H (correspondence set C). In this section, I will argue that the monosyllables in sets B and C were toneless in pA (i.e., *Ø), and that there was a primary split in Metnyo. This split was conditioned by vowel height – *Ø monosyllables with a high vowel nucleus (*i or *u) remained toneless, and *Ø monosyllables with a non-high vowel nucleus (*e, *a, or *o) developed H tone, thus merging with the H monosyllables in correspondence set A.

The relevant data are provided in Table 2. Set B (Metsam Ø :: Metnyo Ø) is given on the left-hand side of the table, and set C (Metsam Ø :: Metnyo H) is given on the right-hand side. To simplify the following discussion, each correspondence set is further subdivided into four groups. The pA reconstructions provided in Table 2 will be justified below – in particular, the segmental reconstructions for groups B.2, B.3, C.2, and C.3.

Table 2: Correspondence sets B (Metsam Ø :: Metnyo Ø) and C (Metsam Ø :: Metnyo H)

Correspondence set B: Metsam Ø ~ Metnyo Ø					Correspondence set C: Metsam Ø ~ Metnyo H				
		Metsam	Metnyo	Proto-Ambel			Metsam	Metnyo	Proto-Ambel
Group B.1					Group C.1				
1.	‘earthquake’	suy	suy	*suy	1.	‘ascend’	sa	sá	*sa
2.	‘enter’	sun	sun	*sun	2.	‘canoe’	wan	wán	*wan
3.	‘five’	lim	lim	*lim	3.	‘fire’	lap	láp	*lap
4.	‘high tide’	nyiw	nyiw	*nyiw	4.	‘full’	fon	hón	*fon
5.	‘honey’	ful	hul	*ful	5.	‘needle’	yam	yám	*yam
6.	‘kill, hit’	bun	bun	*bun	6.	‘night’	gam	gám	*gam
7.	‘king, lord’	fun	hun	*fun	7.	‘rice’	fa	há	*fa
8.	‘know’	un	un	*un	8.	‘sand’	layn	láyn	*layn
9.	‘nine’	siw	siw	*siw	9.	‘betel fruit’	nyan	nyán	*nyan
10.	‘octopus’	kit	kit	*kit	Group C.2				
11.	‘receive’	sin	sin	*sin	10.	‘areca nut’	gey	gíy	*gey
12.	‘river eel’	nyu	nyu	*nyu	11.	‘rain’	mey	míy	*mey
13.	‘thorn’	tun	tun	*tun	Group C.3				
14.	‘white’	bu	bu	*bus	12.	‘coconut’	kowt	kút	*kowt
15.	‘woman’	bin	bin	*bin	13.	‘moon’	town	tún	*town
Group B.2					Group C.4				
16.	‘good’	fey	hey	*fi	14.	‘fish’	dun	dún	? *dun, ?? *don
Group B.3					15.	‘give’	bi	bí	? *bi, ?? *be
17.	‘fart’	sow	sow	? *su					
18.	‘house’	now	now	*nu					
19.	‘rainbow’	wow	wow	*wu					
20.	‘rattan’	dow	dow	? *du					

21.	'two'	low	low	*lu					
Group B.4									
22.	'kind of eagle'	ma	ma	? *ma					
23.	'kind of seaweed'	rom	rom	? *rom					
24.	'water'	we	we	? *we, ?? *wi					

Laying aside the question of tone in proto-Ambel for the moment, let us first consider the segmental reconstructions in sets B and C. The data in groups B.1 and C.1 provide the most straightforward starting point for demonstrating that the majority of the forms in set B can be reconstructed with high vowels, and the majority of those in set C can be reconstructed with non-high vowels. Based on the present-day forms of the cognates, all of the monosyllables in group B.1 are reconstructed with *i or *u, whereas all of the monosyllables in group C.1 can be reconstructed with *a or *o.[11] Comparative data from other RASH languages, such as Ma'ya and Matbat, support these reconstructions, as the vowels of the cognate forms are identical with the Ambel forms (e.g. Ambel *lim* 'five' :: Ma'ya '*li*^{3}*m* :: Matbat *li*^{3}*m*; Ambel *bu* 'white' :: Ma'ya '*bu*^{3}*s* :: Matbat *bu*^{3}*(s)*; Ambel (Mets.) *wan* 'canoe' :: Ma'ya '*wa*^{12}*k* :: Matbat *wa*^{3}*ŋ*; Ambel (Mets.) *fon* 'full' :: Ma'ya '*fo*^{12}*n* :: Matbat *fɔ*^{3}*n*).[12] In other words, 15 of the 24 monosyllables in set B (i.e., 62.5%) can, right off the bat, be confidently reconstructed with a high vowel; and 9 of the 15 monosyllables in set C (i.e., 60%) can be reconstructed with a non-high vowel. This initial patterning of Metnyo toneless monosyllables with high vowels and H monosyllables with non-high vowels at levels that are slightly above chance suggests the preliminary hypothesis that there has been a diachronic relationship between tone and vowel height in this dialect.

[11] In group C.1, there are no monosyllables with /e/ in either dialect. This vowel is comparatively infrequent in Ambel, so this is likely to be an accidental gap.

[12] Unless otherwise noted, the Ma'ya data throughout this paper come from the Salawati dialect. The sources for the Ma'ya data are van der Leeden (n.d.) and Remijsen (2001a), and for the Matbat data, Remijsen (2010, 2015). Superscript numerals are used to transcribe tone in Ma'ya and Matbat; stress is also marked on Ma'ya words.

If we take a closer look at the other cognates in Table 2, we find further evidence in support of this hypothesis. Let us begin with groups B.2 and B.3. At first glance, the data in these groups appear to be counter-examples: in both of the present-day dialects, the monosyllables in these groups have non-high vowel nuclei /e/ or /o/. If we only had data from the two Ambel dialects, we would likely reconstruct 15. 'good' with an *ey rhyme in proto-Ambel, and the forms in group B.3 with *ow rhymes. However, comparative data from other RASH languages suggest that these items can in fact be reconstructed with open syllables with the high vowels *i or *u, at least in proto-RASH. The relevant data are provided in Table 3.[13]

Table 3: Other RASH cognates for groups B.2 and B.3

		Metsam	Metnyo	Other RASH cognates	Proto-RASH
Group B.2					
15.	'good'	fey	hey	As *fi*, Biga *fi*, Buli *mafia*, Gane *fia*, Ma'ya *'fi³*, Matbat *fi³*	*fi
Group B.3					
16.	'fart'	sow	sow	(no data)	? *su
17.	'house'	now	now	Biga *pnu* 'village', Buli *pnu* 'village', Ma'ya *'pnu³* 'village', Matbat *nu³* 'village'	*pnu 'village'
18.	'rainbow'	wow	wow	Ma'ya *'u³*, Matbat *wu⁴¹*	*wu
19.	'rattan'	dow	dow	(no data)	? *du
20.	'two'	low	low	As *lu*, Biga *lu*, Buli *[si]lu*, Gane *plu*, Ma'ya *'lu³*, Matbat *lu³*, Taba *-lu*	*lu

This is the first attempt at reconstructing these forms in proto-RASH – and as can be seen from Table 3, some of the reconstructions lack comparative data in other RASH languages. This is particularly true for 16. 'fart', and 19. 'rattan', for which cognate forms are only attested in the two Ambel dialects.

[13] In addition to the Ma'ya and Matbat sources in footnote 8, data from other RASH languages come from Kamholz (n.d.).

Nonetheless, there is strong evidence from the cognates that 15. 'good' can be reconstructed with a *i vowel nucleus in proto-RASH, and that 17. 'house', 18. 'rainbow', and 20. 'two' can all be reconstructed with *u vowel nuclei; from this we can tentatively infer that other /ow/ sequences in Ambel (e.g. those found in 16. *sow* 'fart', and 19. *dow* 'rattan') have also developed from earlier *u. We can imagine a scenario in which these forms were inherited into pA with the proto-RASH high vowel nuclei in tact, and that there was a subsequent process of vowel breaking, in which open monosyllables with high vowel nuclei diphthongised, such that proto-Ambel *i > Present-day Ambel *ey* (realised [ei]), and proto-Ambel *u > PD Ambel *ow* (realised [ou]).[14] Below, we will return to this scenario, and the relationship between the reconstructed high vowel nuclei and the tone split in Metnyo Ambel.

Turning now to groups C.2 and C.3, we see that the present-day segmental forms are different in the two dialects: in group C.2, Metsam *ey* corresponds to Metnyo *íy*; and in group C.3, Metsam *owC* corresponds to Metnyo *úC* (where *C* = consonant). There is synchronic evidence to suggest that the Metsam rhymes in groups C.2 and C.3 are more conservative, and that there have been two changes (*ey > *íy* and *owC > *úC*) in Metnyo Ambel. In Metnyo, *éy* pronunciations of the forms in group C.2 are very occasionally used as archaic or high-register variants; and the oldest Metnyo speakers (those born before approximately 1940) use *ówC* in free variation with *úC* for the forms in group C.3. The archaic variants of the forms in group C.2 and the synchronic age-graded variation for the forms in group C.3 provide evidence that the Metnyo rhymes are innovative; we can therefore reconstruct *ey rhymes for the monosyllables in group C.2, and *owC rhymes for those in group C.3.[15]

[14] See Arnold (2018a: 53-4) for evidence that these phonetic diphthongs are underlyingly sequences of vowel plus glide, rather than VV sequences.

[15] As 11. 'rain', and 12. 'coconut' are both Ambel innovations, there are unfortunately no cognates from other RASH languages with which to assess these reconstructions. 10. 'areca nut', however, has a RASH cognate in Biga *gey*, supporting the reconstruction of proto-Ambel *gey, with a mid vowel. There are several RASH cognates of 13. 'moon': As *taun* 'star', Fiawat *tun* 'star', Kawe *tun* 'star', Ma'ya (Misool) *to'i^{12}n* 'star', Ma'ya (Salawati) *tu'i^{3}n* 'star', Wauyai *tun* 'star', all probably from proto-Austronesian *bituqen 'star' (Kamholz 2014). As can be seen from these cognates, there is no strong evidence one way or the other regarding the quality of the vowel reconstructed for proto-Ambel.

Before we discuss the data in groups B.4 and C.4, let us take stock. Justifications for the segmental reconstructions for groups B.1-3 and C.1-3 have now been presented. Laying aside groups B.4 and C.4, we have seen there is strong evidence to support the reconstruction of the monosyllables in set B with *i or *u, presuming that the proto-RASH vowels for the forms in groups B.2 and B.3 were inherited in tact into pA (and bearing in mind that in the case of 16. 'fart' and 19. 'rattan', these reconstructions await confirmation from other RASH cognates). We have also seen that there is similarly strong evidence to reconstruct the monosyllables in set C with *e, *a, or *o. The majority of the monosyllables in set B, which in Metnyo Ambel have H tone, can thus be reconstructed with high vowels (19/24, or 79.17%, if we do not include 17. 'fart' and 20. 'rattan'); similarly, the majority of monosyllables in set C, which are toneless in Metnyo, can be reconstructed with non-high vowels (13/15, or 86.67%). The relationship between the variables is highly significant, χ^2 (1, N = 39) = 16.1, p = 0.00006, showing that the observed patterns are extremely unlikely to be due to chance. I suggest here that the most likely scenario that can account for these data is that the monosyllables in sets B and C were toneless in pA, and that the height of the vowel conditioned a primary tone split in Metnyo, with high vowels remaining toneless, and non-high vowels merging with the H monosyllables in set A.

However, the cognates in groups B.4 and C.4 constitute exceptions to these conditions. None of the monosyllables in group B.4 can be confidently reconstructed with high vowels, and none of the monosyllables in group C.4 can be reconstructed with non-high vowels.[16] Despite these exceptions, the

[16] There are, however, some observations that can be made about the data in groups B.4 and C.4. The first observation concerns the two monosyllables in group C.4, *dun* 'fish' and *bi* 'give'. The cognates of both these monosyllables in Ma'ya and Matbat have non-high vowels: Ambel (Mets.) *dun* 'fish' :: Ma'ya '*do*^{3}*n*; Ambel (Mets.) *bi* 'give' :: Ma'ya '*be* :: Matbat *be*^{21}. However, the correspondence Ambel *un* :: Ma'ya *on* is not regular (cf. Ambel *un* 'know' :: Ma'ya '*un*; Ambel *fon* 'be full' :: Ma'ya '*fo*^{12}*n*); nor is the correspondence *i :: e* (cf. Ambel *sí* 'genitals' :: Ma'ya '*si*^{3}; Ambel *be* 'put (in a place)' :: Ma'ya '*be*). It is possible that the pA forms were *don 'fish' and *be 'give', and that the changes *don > *dun* and *be > *bi* were sporadic; but this is speculation. (See Gil 2017 for an extensive discussion of macrofunctional forms cognate with Ambel *bí* 'give' in other SHWNG languages.)

Of the three monosyllables in group B.4, only one, *we* 'water', has an Austonesian etymology (< proto-Central-Eastern Malayo-Polynesian *waiR 'fresh water'; Kamholz 2014). It is unclear why this item remained toneless, rather than developing H tone as predicted by the stated conditions; RASH cognates do not suggest an earlier high vowel (e.g. As *wɛʔ*, Biga *wey*, Buli

conditioning effect of vowel height on the tone split in Metnyo Ambel is strongly supported by the data in Table 2: conservatively (i.e., not including the monosyllables in groups B.4 or C.4, nor the reconstructions for 16. 'fart' or 19. 'rattan'), of the 39 monosyllables in Table 2, the stated conditions account for the tone of 32 of the Metnyo reflexes (i.e., 82%).

3.3 Correspondence sets D and E: Metsam LH :: Metnyo Ø, H

Only five Metsam LH monosyllables with cognates in Metnyo have so far been identified. Of these, four correspond to Ø monosyllables in Metnyo (correspondence set D), and one corresponds to a H monosyllable (correspondence set E). The data are provided in Table 4 (set D on the left, set E on the right). The proto-Ambel reconstructions are provided to facilitate discussion.[17]

Table 4: Correspondence sets D (Metsam LH :: Metnyo Ø) and E (Metsam LH :: Metnyo H)

Correspondence set D: Metsam LH ~ Metnyo Ø					Correspondence set E: Metsam LH ~ Metnyo H				
		Metsam	Metnyo	proto-Ambel			Metsam	Metnyo	proto-Ambel
1.	'charcoal'	kŏwn	kun	*kŏwn	1.	'paddle'	pŭ	pú	*pŭs
2.	'current'	mŏ	mo	*mŏ					
3.	'louse'	ŏwt	ut	*ŏwt					
4.	'sago'	bĕy	bey	*bĭ					

waya, Fiawat *wey*, Gane *waya*, Gebe *wa*, Kawe *'way[a]*, Laganyan *'way[a]*, Ma'ya *'waya³*, Sawai *wɔɛ*, Taba *woya*, Wauyai *'way[a]*). The other two monosyllables in group B.4, *ma* 'kind of eagle' and *rom* 'kind of seaweed', do not have an Austronesian origin. This is true of a large proportion of basic vocabulary in Ambel: Remijsen (2001a: 102-4) hypothesises that a now-extinct non-Austronesian language with which Ambel was once in contact may account for this non-native vocabulary. It is therefore possible that these two monosyllables are borrowings from this unidentified non-Austronesian substrate. This could explain why they constitute exceptions to the stated conditions: they were borrowed after the tone split in Metnyo had occurred.

[17] 1. 'paddle' is reconstructed with final *s. This is for two reasons. First, the cognate forms in RASH languages suggest a final *s (e.g. Ma'ya *po¹²s*, Matbat *po¹s*). Second, as will be discussed in section 3.4, if the proto-Ambel syllable had have been open (as the cognate forms in the two dialects suggest), it would have fed the vowel breaking change discussed for group B.3 in section 3.2, i.e. the expected reflex would be unattested **pow.

There are too few data to draw any firm conclusions about the reconstructions for sets D and E. However, from what is available, it seems likely that Metsam LH is a reflex of proto-Ambel *LH, and that *LH monosyllables merged with Ø in Metnyo. Evidence for this comes from an already near-complete merger of LH and Ø syllables in present-day Metsam – due in part to an utterance-final postlexical HL% boundary tone, and in part to the [H] target of LH syllables often not being realised utterance-medially in rapid speech.

The HL% boundary tone is used in both Ambel dialects to mark declarative and imperative utterances (see Arnold 2018b). In Metsam, the result of this boundary tone is that the realisation of LH and Ø syllables merge in utterance-final position, i.e. both are realised [LHL]. If an utterance-final syllable is Ø, the first [L] component of the [LHL] realisation is the realisation of tonelessness as [L], and the [HL] component is a realisation of the HL% boundary tone. If the syllable is LH, however, then the [LH] component of the [LHL] realisation is derived from lexical /LH/; the [H] component of the HL% boundary tone applies vacuously, and the [L] component of the [LHL] realisation is the realisation of the second component of the boundary tone.

In addition to this context-dependent complete merger of Ø and LH utterance-finally, there is also often a similar merger in utterance-medial position. In careful speech, utterance-medial LH monosyllables in Metsam are realised [LH]; however, in fast speech the [H] target is often not reached, and the syllable is simply realised [L], i.e. the same as Ø syllables. In the present day, LH and Ø syllables in Metsam are already becoming difficult to distinguish, particularly in rapid speech; it is not hard to imagine a similar scenario in Metnyo, in which the LH and Ø distinction ultimately collapsed.

Unlike the primary split of *Ø monosyllables discussed in the previous section, the merger of *LH and Ø in Metnyo Ambel was unconditioned. As described above, *Ø monosyllables with non-high vowels developed H tone in Metnyo – but pA *kŏwn ‘charcoal’, *mŏ ‘current’, and *ŏwt ‘louse’, all with non-high vowels, became toneless in Metnyo. The merger of *LH and Ø must therefore have occurred after the Metnyo split of *Ø into H and Ø – if it were

ordered before, we would expect the merger to have fed the split, and thus for *mŏ ‘current’, with a low vowel, to have developed H tone in Metnyo.

It is unclear why pA *pŭs ‘paddle’ has the reflex *pú*, with H tone, in Metnyo; based on the reflexes of the other four *LH monosyllables, we would expect it to be toneless. More data from other monosyllables bearing LH in Metsam are required to explore whether the development of H tone on this monosyllable was a sporadic change, or whether it was conditioned by some segmental factor.

3.4 Summary

Now that tonal correspondences between the Metsam and Metnyo Ambel cognates have been identified, and we have reconstructed the proto-Ambel forms, the tonal and segmental changes in the two dialects can be summarised.

In proto-Ambel, monosyllables were *H, *LH, or *Ø. Monosyllables in correspondence set A are reconstructed *H; those in sets B and C are reconstructed *Ø; and those in sets D and E are reconstructed *LH. These reconstructions are identical with the tonal specifications in present-day Metsam, i.e. Metsam is conservative in its tonal phonology. The tonal phonology of Metnyo, however, has undergone two innovations – the primary split of *Ø (and the subsequent merger with *H), and the unconditioned merger of *LH with Ø. Segmentally, several pan-Ambel changes have also occurred, as well as some changes specific to the Metnyo dialect, to give the reflexes seen today.

The first innovation was in Metnyo, at stage 1, which was the split of *Ø monosyllables conditioned by vowel height. At some unknown point after this split, *LH monosyllables in pre-Metnyo lost their tonal specification, in an unconditioned merger with Ø syllables. As described above, this merger of *LH and Ø in pre-Metnyo must have occurred after pA *Ø split. If the merger and the split had occurred in the opposite order, i.e. if *LH and Ø had merged in pre-Metnyo prior to *Ø splitting, the *LH and Ø merger would have fed the split: we would have to explain why reflexes of *kowt ‘coconut’ and *town ‘moon’ are H in Metnyo, but reflexes of *ŏwt ‘louse’ and *kŏwn ‘charcoal’ are not.

Following the split of *Ø in pre-Metnyo, several segmental changes occurred – some in pre-Metnyo, some in both dialects. The first, at stage 2, was the raising of the pre-Metnyo vowels in *méy 'rain' and *géy 'areca nut', giving the present-day forms *míy* 'rain' and *gíy* 'areca nut'. This was followed, at stage 3, by the pan-Ambel breaking of the high vowels *i and *u in open syllables to *ey and *ow, respectively (seen in e.g. pA *fi 'good' > Mets. *fey*, Metn. *hey*; pA *nu 'house' > Mets., Metn. *now*). This change was ordered after the raising of *ey > *iy* in Metnyo – if the breaking of *i > *ey* had occurred before the raising of *ey > *iy*, it would have fed the raising and we would expect, for example, the unattested Mets. ***fiy*, Metn. ***hiy* 'good'. Following this, at stage 4, there was another pan-Ambel change, in which monosyllables reconstructed with *us rhymes (viz. *bus 'white', *pŭs 'paddle') lost the *-s coda; again, this change must have occurred after the breaking of *u in open syllables, so that the outcomes of *-s deletion did not feed this breaking. More recently, at stage 5 (which, based on synchronic variation, began in the last seventy years or so), Metnyo monosyllables with the rhyme *owC* monophthongised to become *uC*, thus pre-Metn. *kówt 'coconut' > Metn. *kút*, pre-Metn. *owt 'louse' > *ut*; and pre-Metnyo *f debuccalised to become *h*, thus pre-Metn. *fát 'four' > Metn. *hát*, pre-Metn. *fun 'king' > Metn. *hun*.

The changes discussed in this section are summarised in table 5.

Table 5: Summary of the phonological changes in Metsam and Metnyo Ambel

Stage	Metsam	Metnyo
1		**Split of toneless monosyllables, conditioned by vowel height:** *Ø > Ø (high vowels *i, *u) e.g. pA *fi 'good' > pre-Metn. *fi pA *bus 'white' > pre-Metn. *bus *Ø > H (non-high vowels *e, *a, *o) e.g. pA *gey 'areca nut' > pre-Metn. *géy pA *wan 'canoe' > pre-Metn. *wán pA *fon 'full' > pre-Metn. *fón
(1 >)		**Merger of *LH and toneless monosyllables**: e.g. pA *ŏwt 'louse' > pre-Metn. *owt pA *bĭ 'sago' > pre-Metn. *bi
2		**pre-Metn. *éy > *íy*** e.g. pre-Metn. *méy 'rain' > *míy* pre-Metn. *géy 'areca nut' > *gíy*
3	**Pan-Ambel diphthongisation of high vowels in open monosyllables** *i > *ey* /#C ___ # e.g. pA *fi 'good' > Mets. *fey*, Metn. *hey* *u > *ow* / #C ___ # e.g. pA *lu 'two' > Mets., Metn. *low*	
4	**Pan-Ambel loss of *-s in *us rhymes** e.g. pA *bus 'white' > Mets., Metn. *bu*	
5		**a) Monophthongisation of pre-Metnyo *owC rhymes** e.g. pre-Metn. *kówt 'coconut' > *kút*, pre-Metn. *owt 'louse' > *ut* **b) Debuccalisation of pre-Metnyo *f > *h*** e.g. pre-Metn. *fát 'four' > *hát*, pre-Metn. *fun 'king' > *hun*

4. Discussion: The relationship between vowel quality and tone

The most significant finding of this study regards the tone split conditioned by vowel height in Metnyo Ambel. The influence of vowel height on the development of phonological tone is so rarely attested that some have claimed that vowel height and tone never interact (e.g. Hombert 1977, 1978; Hombert et al 1979; cf. the discussions in Kingston 2011: §6; Köhnlein & van Oostendorp 2017: §2). However, as more data from a wider range of languages are analysed, there is increasing evidence that vowel quality can affect the realisation and development of tone, albeit infrequently.

A synchronic relationship between tone or pitch and vowel quality has now been reported in over a dozen languages (see Becker & Jurgec 2017: 11-14 for a comprehensive overview). In most cases, higher or more tense vowels are associated with higher tone or pitch. For example, in Hu (an Angkuic language), high vowels in open syllables can bear either H or L tone, but high vowels in closed syllables can only bear H tone (Svantesson 1991); in Shinasha (Omotic), the H tone has two allotones, [High] realised on non-high vowels, and [Extra-High] realised on high vowels (Tesfaye & Wedekind 1994); and a preference for High tone to occur with [+ATR] vowels in Slovenian means that the vowels of loanwords, which are automatically assigned High tone, are tensed (Becker & Jurgec 2017). In some cases, a synchronic relationship is reported between higher vowels and Low tone: in Ngizim (Chadic), for example, the major pattern of trisyllabic verbs is for the final syllable to bear H tone, the medial syllable to bear L, and for the initial syllable to be L if the vowel is /i/ or /u/, and H if the vowel is /a/ or /aa/ (Schuh 1971).

A diachronic effect of vowel quality on tone, like the one described in this paper, has been reported in fewer languages. However, in all of the cases described so far, higher/tense vowels are associated with High or Extra-High tone, and lower/lax vowels are associated with Low tone. One such example is that of the Angkuic language U, described in Svantesson (1988, 1989). In U, vowel height played a role in tonogenesis: originally open syllables which had at least one prevocalic voiceless obstruent developed H tone if the vowel was high (*i or *u), and L tone if the vowel was non-high. In Limburgian Dutch, an

originally phonetic distinction between long non-high vowels realised with acute accent (Accent 1) and long high vowels realised with circumflex accent (Accent 2) was phonemicised when short vowels in open syllables lengthened and also acquired the circumflex accent (Boersma 2017). In the Omotic language Bench', an Extra High tone developed through the phonemicisation of an earlier allophonic raised pitch on high vowels bearing H tone (Wedekind 1985; Tesfaye & Wedekind 1994). Andersen (1986) reports a similar tone split, in this case conditioned by contrasting ATR values, in the Moru-Madi language Lugbara: in the western dialect, vowel mergers meant that a formerly predictable extra-high pitch realised on syllables with [+ATR] vowels bearing H tone became phonemicised. In Cèmuhî, a tonal Oceanic language spoken in New Caledonia, the reflex of the proto-sequences *aqa, *ao, and *oa, all with low vowels, is Low-toned *à* (Rivierre 2001). Kamholz (2014: 106-114) describes how word-final *a* triggered a tone shift from *High > Low on either the second mora of the penult or on word-final syllables in Yerisiam, a SHWNG language. Finally, in Ma'ya, a RASH language that has already been mentioned several times in this paper, Arnold (2018c) describes a tone split affecting syllables reconstructed with *High tone in a common ancestor to Ma'ya and Matbat, whereby syllables with a high vowel nucleus *i or *u remained High, while those with a non-high nucleus *e, *a, or *o developed Rise tone.

The tone split described in this paper for Metnyo Ambel, however, is the first attested case of the development of High tone on lower vowels. In the remainder of this section, the possible mechanisms that caused this split in Metnyo will be explored.

The development of higher tones from high vowels has a strong phonetic motivation. All things being equal, higher vowels are produced with a higher fundamental frequency (*f*0) than lower vowels – a finding universally reported in 31 languages across 11 different language families (see Whalen & Levitt 1995 for cross-linguistic survey). [18] This phenomenon is referred to as 'intrinsic

[18] Thus far, the only language that has been shown not to have a statistically significant difference in *f*0 between high and low vowels is the Bantoid language Mambila. This is possibly explained by the large number of bi- and tritonal contours arising from lexical and grammatical

fundamental frequency' (IF0); the average cross-linguistic difference in IF0 between high and low vowels is around 15.3 Hz (Whalen & Levitt 1995: 356).[19] The phonologisation of IF0 differences between higher and lower vowels neatly explains the observation that in most cases of the diachronic development of tone from vowel height, higher vowels develop higher tone.

How then to account for the development of High tone on non-high vowels in Metnyo Ambel? A second finding from Whalen & Levitt (1995) is relevant here: in all of the tonal languages in their survey, IF0 is reduced or even neutralised for vowels bearing the lowest tones. This finding is supported in Connell (2002), where it was found that the IF0 differences in four tonal African languages are the smallest on Low-toned vowels. Ladd & Silverman (1984) additionally found that, in German, the difference in IF0 was the smallest in prosodic contexts where the pitch is low (e.g. in phrase-final contexts), suggesting that IF0 differences are also reduced at the lower end of a speaker's pitch range in non-tonal languages.

These findings go some way to explaining why it was not higher vowels that developed High tone in Metnyo Ambel, as was the case in the other languages discussed above. Recall that proto-Ambel vowels were *H, *LH, or *Ø, and that it was *Ø vowels that were targeted by the split. *Ø vowels would presumably have been realised [L], as they are in present-day Metsam and Metnyo; of the three specifications, *Ø syllables would therefore have been realised with the lowest pitch. In this context, if IF0 were reduced or neutralised for vowels in toneless

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combinations of four level tones, and the short *f*0 spans involved in these contours, leading to a particularly 'crowded' tonal space in Mambila – see Connell (2002) for results and discussion.

[19] The precise cause of IF0 remains a matter of debate. Broadly speaking, there are two camps. The first camp advocates a physiological explanation, in which higher *f*0 is an automatic consequence of the successful articulation of higher vowels. Most commonly, this view takes the form of the 'tongue pull hypothesis', in which the raising of the tongue to articulate higher vowels leads to tensing of the vocal cords, and thus higher *f*0 (see e.g. Lehiste 1970; Ohala 1972; Honda 1981; Ohala & Eukel 1987; Whalen & Levitt 1995; Whalen et al 1995; Whalen et al 1998). The second explanation is the 'enhancement hypothesis', in which speakers consciously manipulate *f*0 in order to maximise the phonological distinction between high and low vowels (see e.g. Diehl 1991; Kingston 1992; Kingston & Diehl 1994). Some (e.g. Fischer-Jørgensen 1990; Connell 2002; Van Hoof & Verhoeven 2011) argue that the tongue pull and enhancement hypotheses are in fact not mutually exclusive – while IF0 may be an automatic feature of vowel production, some languages may exploit IF0 to a greater extent than others in order to enhance the phonological contrast of vowel height. See Sapir (1989) and Silverman (1987) for detailed overviews of the various hypotheses.

syllables, then we would not predict high vowels to develop High tone as the result of IF0 differences. This is in contrast to the other languages discussed above, in which IF0 differences were available for phonologisation – either because a tone split targeted a High-toned vowel (as in Lugbara, Gimina, Yerisiam, and Ma'ya), or because the language was originally atonal (as in U, Limburgian Dutch, and Cèmuhî).

If IF0 were neutralised for *Ø vowels in proto-Ambel, this would clear the way for another phenomenon to take precedence: that of intrinsic pitch (IP). While IF0 is the universal realisation of higher vowels with higher *f*0, IP is an auditory mechanism by which, paradoxically, hearers perceive higher vowels as *lower* in pitch than lower vowels. For example, in Hombert (1977), three synthesised vowels [i], [a], and [u] were presented pairwise to speakers of American English, who were asked to choose which of the two vowels was higher in pitch. When an identical *f*0 was superimposed on both vowels, there was a strong tendency for [a] to be judged as higher in pitch in the [i-a] and [u-a] pairs (71.39% and 72.5% respectively; compare the [i-u] pairs, where [i] was judged to be higher only 51.39% of the time). Similar results have been reported for English and other Germanic languages in Chuang & Wang (1978), Stoll (1984), Silverman (1987), Fowler & Brown (1997), and Pape & Mooshammer (2006). IP is thought to be an auditory compensation for the effects of IF0, so that vowels will be perceived as the same pitch even when *f*0 differs – as such, it is an example of what Gussenhoven (2007) refers to as 'compensatory listening'.

Unlike IF0, it is unclear whether IP is a universal phenomenon. It has thus far only been demonstrated in Germanic; Pape & Mooshammer (2006) show that IP is not present in Italian, suggesting that it is not universal. Indeed, the development of High tone from the higher IF0 of higher vowels described in the languages above implies that at least some languages do not utilise IP: if all languages did, then the higher IF0 of higher vowels would not be perceived by listeners, and thus there would be no signal from the pitch of the vowel for the listener to reinterpret as High tone.

However, if speakers of proto-Ambel did utilise a compensatory IP strategy in a similar way to speakers of English and other Germanic languages, a picture

of how non-high *Ø vowels became H in Metnyo begins to emerge. As will be discussed in the following section, Arnold (2018c) hypothesises that the extant Ambel tone system cannot be reconstructed any higher in RASH than proto-Ambel, i.e. tone was innovated in proto-Ambel. Before tonogenesis, in atonal pre-proto-Ambel, IP was used to compensate for automatic IF0 differences, which at that point affected all vowels. Once proto-Ambel acquired tone, IF0 differences were reduced for the vowels realised with the lowest pitch, i.e. *Ø syllables. If speakers continued to compensate for former IF0 differences on these syllables after the differences were reduced, then *Ø syllables with the non-high vowels *e, *a, or *o would be perceived as higher in pitch than those with the high vowels *i or *u (even though we predict the *f*0 to have been roughly the same). These non-high vowels were thus reanalysed as bearing High tone, and merged with the other *H-toned syllables.

Before moving on to a discussion of potential sources of tone in proto-Ambel, it is worth noting that, of the eight cases described so far of the diachronic development of tone from vowel height, four – Ambel, Ma'ya, Yerisiam, and Cèmuhî – belong to the hypothesised Eastern Malayo-Polynesian (EMP) branch of Austronesian, i.e. are SHWNG or Oceanic languages (Blust 1978). Blust (2005, 2017) discusses unusually-conditioned phonological developments unexpectedly clustering within genetic groupings elsewhere in Austronesian; he suggests this kind of clustering '…implies the continued operation of an inherited structural pressure after the separation of the daughter languages from a common ancestor' (2017: 342). In the case of these EMP languages, the structural pressure appears to be linked to the relationship between the height of a vowel and its intrinsic *f*0 – perhaps EMP languages have a stronger-than-average correlation between *f*0 and vowel height, such that the difference in IF0 between high and low vowels in EMP languages is larger than the cross-linguistic average of 15.3 Hz reported in Whalen & Levitt (1995: 356). IF0 has not thus far been investigated for any EMP language, tonal or atonal; whether this prediction is borne out is therefore a question for future research.

5. THE SOURCE OF TONE IN PROTO-AMBEL

This paper has discussed the development of the Metsam and Metnyo Ambel tone systems from proto-Ambel. The question naturally arises, then, as to the origin of tone in proto-Ambel.

It was mentioned in section 2 that there are at least two other tonal RASH languages spoken in Raja Ampat – Ma'ya and Matbat – and that there may be several others. To test the hypothesis that the tone systems of proto-Ambel, Ma'ya, and Matbat were inherited from a common ancestor, Arnold (2018c) compares monosyllabic cognates between the three languages. Systematic correspondences between Ma'ya and Matbat are found, demonstrating that these two languages have inherited their tone systems from a common ancestor. However, no correspondences were found between proto-Ambel and Ma'ya and Matbat, suggesting that proto-Ambel developed tone independently.

Arnold (2018c) then attempts to determine whether proto-Ambel tone developed spontaneously, through the phonemicisation of an earlier phonetic pitch difference conditioned by segmental features (for example, through the transfer of laryngeal features of an onset voicing contrast to the following vowel; see e.g. Hombert et al 1979); or whether tone developed through contact. In order to test the first hypothesis, Arnold examines proto-Ambel words with Austronesian etymologies. No obvious segmental predictors of tone are found. In lieu of evidence for spontaneous tonogenesis, the most likely explanation for the development of tone in proto-Ambel is therefore contact with a tonal language.

The identity of this language, however, remains unknown. It was mentioned above that contact with a now-extinct Papuan substrate likely accounts for the large proportion of non-Austronesian vocabulary in Ambel.[20] While the majority of Papuan languages are not tonal, tone is not an uncommon feature in the non-Austronesian languages of New Guinea (Foley 1986: 63-64). It is therefore possible that this substrate was also tonal. Two Papuan languages, Moi and Duriankari, have been spoken to a limited extent in Raja Ampat for at least 100

[20] 'Papuan' is used here to refer to the genetically diverse non-Austronesian languages spoken on and around New Guinea; the term is not intended to imply a genetic relationship.

years (Remijsen 2001a: 30-31).[21] However, both of these languages are relatively recent incomers to the archipelago, with speakers having migrated from the Bird's Head Peninsula of New Guinea (the closest mainland to Raja Ampat); neither of them are spoken on Waigeo, so speakers are unlikely to have been in close contact with speakers of proto-Ambel; and neither Moi nor Duriankari is tonal. In the absence of further evidence, these languages are therefore unlikely to have been the source of tone in proto-Ambel.

However, there are several more Papuan languages spoken on the Bird's Head Peninsula, five of which are tonal: Mpur (Odé 2002a: 50-51, 2002b), Abun (Berry & Berry 1999: 20-22), Sougb (Reesink 2000, 2002: 194-196), Meyah (Gravelle 2002: 121-123, 2004: 44-54), and Moskana (Gravelle 2010: 49-55).[22] All of these languages have simple tone systems, contrasting two or three tones. One or more tonal Papuan languages, possibly genetically related or typologically similar to one or more of these languages, may also once have been spoken in Raja Ampat – contact with this/these language(s) may have led to tonogenesis in proto-Ambel. An alternative hypothesis is that it was contact with tonal proto-Ma'ya-Matbat (or one of its descendants) that triggered tonogenesis in proto-Ambel. Further research is required before progress can be made with this question: first, to identify possible extant relatives of the Papuan source of the non-Austronesian words in Ambel; and second, to sift out cognates from forms borrowed from proto-Ma'ya-Matbat or its descendants, in order to determine whether there is any relationship between the tone of borrowed forms in Ambel, Ma'ya, and Matbat that might indicate contact-induced tonogenesis.

6. Conclusions

This paper started out by taking the first steps in the reconstruction of the word-prosodic system of proto-Ambel, using data from monosyllabic cognates in the two present-day dialects, Metsam and Metnyo. Proto-Ambel is reconstructed

[21] De Vries (1998: 644) reports that Duriankari may now be extinct.

[22] Mpur and Abun are both isolates; and Sougb, Meyah, and Moskana together comprise the East Bird's Head family (Voorhoeve 1975, Reesink 2002).

with two tones, *High and *Rise; toneless monosyllables are also reconstructed. Some progress has therefore been made. It is anticipated that the tonal and segmental reconstructions presented in this paper will feed into further comparative SHWNG studies. In particular, the proto-Ambel reconstructions can now be compared with data from other RASH languages, in order to address the question of the internal subgrouping of RASH. These comparisons have already begun – in Arnold (2018c), it is shown that tone has developed twice in the Austronesian languages of Raja Ampat: once in proto-Ambel, once in an ancestor to Ma'ya and Matbat. It was mentioned above that at least some of the other RASH languages spoken in Raja Ampat may also have tone systems. Further data are required from these languages, first to determine whether they are indeed tonal; second, if they are, to analyse the tone systems; and third, to compare these systems with data from Ambel, Ma'ya, and Matbat, to determine whether these languages have inherited tone from the same source as either proto-Ambel or the tonal ancestor of Ma'ya and Matbat. Data from these other RASH languages may also contribute to the question of tonogenesis in the Austronesian languages of Raja Ampat, in particular the identity of the source language(s) in the case of contact-induced tonogenesis.

However, several questions about the nature of the word-prosodic system of proto-Ambel are not yet answered. Most notably, due to the preliminary state of research on the word prosody of Metsam Ambel, it is unclear at present whether tone was either obligatory or culminative in proto-Ambel polysyllables; or whether tone targeted the syllable or the word. It is also unknown whether proto-Ambel just had lexical tone, as in Metnyo Ambel; or whether it combined lexical tone with lexical stress, as in related Ma'ya. In order to answer these questions, more polysyllabic data from the Metsam dialect are required, to further analyse the present-day system, and to reconstruct proto-Ambel polysyllables. These data should be collected as a matter of urgency: the Metsam dialect is only spoken by those born before about 1960, and is thus highly endangered.

In the course of reconstructing proto-Ambel monosyllables, we stumbled across a curious sound change in Metnyo Ambel: a previously unattested tone

split conditioned by vowel height, in which toneless monosyllables remained toneless if the vowel was high (*i or *u), or merged with H-toned monosyllables if the vowel was non-high (*e, *a, or *o). As was described above, the development of High tone from high vowels has an obvious phonetic motivation, in that higher vowels are produced with an intrinsically higher *f*0 than lower vowels. The development of High tone on non-high vowels, however, is a little trickier to account for. Using experimental phonetic evidence, a scenario was presented in which, following tonogenesis in proto-Ambel, intrinsic *f*0 differences were neutralised on vowels in toneless syllables; but speakers of proto-Ambel continued to compensate for these intrinsic *f*0 differences, using Intrinsic Pitch. In this scenario, proto-Ambel speakers continued to perceive lower vowels as higher in pitch, even once the IF0 differences were reduced or neutralised for vowels in toneless syllables. Over time, these lower toneless vowels were eventually reanalysed as bearing High tone, and merged with the already-existing High.

The mechanisms causing the split are admittedly speculative, pending further research into the relationship between intrinsic *f*0, Intrinsic Pitch, and developments in phonological tone. However, the more concrete finding that H tone developed on non-high vowels in Metnyo Ambel is highly significant from both a historical and a theoretical perspective. First, this split contributes to the growing body of evidence demonstrating that, contrary to what some have claimed, vowel height can and does condition diachronic tonal developments. Even more significant, however, is the demonstration that High tone does not always develop on higher vowels, as has been the case in the other attestations discussed so far in the literature; but that High tone can, in the right circumstances, develop on lower vowels.

Finally, the frequency with which tonal developments conditioned by vowel height occur in the Eastern Malayo-Polynesian branch of Austronesian was commented upon. It was suggested that this may be due to EMP languages having a greater-than-average IF0 (possibly compensated for by a greater-than-average IP in proto-Ambel). This hypothesis would be easy enough to test with

experimental phonetic data from speakers of EMP languages, and thus the answer to this question awaits future research.

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